ART. III.—*On the Geological distribution of Gold, with special reference to some Auriferous Rocks in South America.* By P. NISSER, ESQ., many years practically engaged in the Gold Mines of that country.

[Read before the Institute, 30th March, 1859.]

To the question—"Where is gold to be found?" great authorities have given the following answer:—"Gold is found in the rocks of igneous origin, in the Azoic and Palæozoic metamorphic rocks, also among the drifts of diluvial and alluvial deposits,* as the results from disintegration of the auriferous compounds in the rocks."

By this general definition of the geological position of gold, we will here take a view of this metal, under two heads, viz., *Gold in the Rock* and *Fluvial Gold.*

GOLD IN THE ROCK.

Gold is found in the fissures of the rocks filled with minerals and metallic compounds, forming veins. The rocks in which such auriferous veins are found may be classed under four groups—the volcanic, trappean, granitic, and most of the metamorphic rocks.

Among the rocks producing auriferous materials some rare exceptions exist where gold occupies the whole mass of the rock. As some of these may not yet be known, a view of the same is here offered:—*Silurian epoch—a rock of a silico-argillaceous composition,* having the appearance of schist, containing particles of quartz and iron-oxide, intimately mixed and bound together with clay, being hard and compact, of an uneven fracture; colour green or dark grey. Small fissures divide the almost vertical stratification into small, irregular, angular compartments, the fissures of which are occupied with a coating of minute *quartz crystals, i. e.,* both sides of these fissures are studded with the crystals, the fissures being $\frac{1}{8}$ to $\frac{1}{4}$ of an inch wide. The seams so coated

* The geological periods for *diluvial* and *alluvial* gold will be given under fluvial gold. The term fluvial expresses auriferous detritus of the earliest and latest geological dates.

constitute the characteristic of this rock. At the base of the crystals and beneath the same in the exterior part of the mass of the rock, gold is distributed; also among, but not within, the crystals, though a few exceptions have been noted.* Small seams of $\frac{1}{4}$ to $\frac{3}{8}$ of an inch traverse the rock, contrary to the cleavage (in N.W. by S.E.), filled with compact quartz, stained with per-oxide of iron, some pyrites, and yellow iron-ochre in abundance; but here rarely any gold is to be seen. The pulverized mineral produces diminutive particles of gold by the process of washing, the most of which have the appearance of fragmentary *gold-leaf* floating on water. We often meet with finely divided gold, which floats on water, but on nearer examination we find that such particles, when from the veinstone, are of an angular form. In this locality it is as it were small portions of gilders' gold, the least breath moving the same, just like particles of a feather. Certainly, this kind of gold is among singular exceptions, and of great interest respecting the *modus operandi* by which it has been disseminated. Thus the rock in which it appears may be viewed among gold-bearing curiosities. The said rock was discovered in the province of Cauca, of N. Granada, in 1850.

It is said that sandstone of the Lias group, containing gold disseminated in small particles, has been found in Hungary. This rock, as observed in the northern districts of S. America, has not proved auriferous.

In the Brazils, the following auriferous rocks were found many years ago:

A Conglomerate, consisting of angular fragments of specular and magnetic iron-ore, occasionally containing fragments of flexible sandstone (itacolumite) of a pale-red hue, sometimes having fragments of chlorite and talc-schists, these fragments embedded in a cement of a ferro-argillaceous composition, forming a compact rock, occupying the top as well as the slope of the hills and also the valleys, resting on micaceous and clay-slates and on a schist of specular iron-ore.

* In California, I was gratified in seeing a rare specimen of a group of auriferous quartz-crystals (the largest of which was about 2 inches in height, and presented facets of nearly $\frac{3}{8}$ of an inch) occupying a piece of micaceous clay slate, in size about 7 inches by 4. This group was surrounded with small closely studded crystals which covered the fragment. Gold, in a varied angular shape, was abundantly spread among the smaller, and particularly at the base of the larger crystals. Three or four of the latter *enclosed several gold particles*, which were seen in the centre of the lower portion of the same.

The thickness of this conglomerate amounts to several feet. In the mass of this rock, but not in the fragmentary particles, *gold*, in flattened spangles of very small size, is disseminated. In some of the fragments is seen silicious oxide of manganese and some other ores of manganese, occasionally with particles of sub-phosphate of alumina (wavellite). This conglomerate exists in the mining district of *Minas Geraes*, where it is distinguished by the name of TAPANHOACANGA.

In the same district has also been found and profitably worked, another exceptional gold-bearing rock, viz.:—

In clay or chlorite schists is seen a large chasm, in the form of a dyke, filled with iron-ore, of a deep brown, nearly black colour, partly decomposed, occupying a width of 200 feet, with an inclination of 45° N. in E. and W. Through this mass traverse numerous seams in the said direction and angle, their thickness varying from one to four inches, filled with manganese, bi-sulphuret of iron, mostly decomposed, and argillaceous per-oxide of iron—a hard iron-clay. The pyrites and the iron-clay have proved very rich in gold of a diminutive angular shape. This ferruginous compound, with its auriferous seam, is termed by the natives YACATINGA.

In the province of Antioquia, of N. Granada, the following auriferous rock was discovered in the year 1840. The locality was visited by the writer soon after. A sloping hill forms the division between the rivers Samaná and Barcino. The object of our attention occupied the lower portion of the ridge, and close to the junction of the said rivers, at an elevation of 1620 feet over the watercourse. Throughout the whole mass *gold* is disseminated in large and also in very small particles of irregular shape, having rough and sharp outlines, partly fungiform; but among the pyramidal agglomeration of perfectly spherical fragments of the mass occupying the centre of the same, and in the seams forming angular divisions, which are filled with per-oxide of iron and hardened clay, not even traces of gold have been found. At the upper portion of the conglomerate and close to the surface, three seams of two to three inches width were seen, filled with quartz, some pyrites and hydrous oxide of iron, also some ferruginous hard clay, which proved to be very rich in gold. These seams, which extended for a short distance in length and depth, commenced about three or four feet below the surface, and, after having disappeared at a moderate depth, never re-appeared; nor were any other seams or veins of the kind encountered in this part of the rock. The gold ex-

tracted from the seams presented exteriorly exactly the same appearances as that disseminated in the mass, and the quality proved also to be the same.

This conglomerate was found auriferous for several hundred feet in length, but at the depth of about 80 feet the mass became too hard for the pick or the crow-bar, and the productiveness also declined. That a composition such as here described produces gold throughout the mass, is certainly a novelty, considering its geological position. Though no fossils whatever have been discovered, it appears that this mass had formed long before the tertiary era or the Eocene epoch. It is, however, a curious exception to find gold so distributed, as it appears here spread among the binding ingredients; and, further, that the quality and appearance of the gold from this rock do not correspond with the fluvial gold, as seen in this part of the world, a circumstance which speaks in support of what has been suggested, viz., that this auriferous deposit is of anterior date to the fluvial depositions containing gold.

We have next to consider a most singular feature, which is never observed among fluvial drifts, *i.e.*, the superficial seams filled with partly drusy quartz where free gold is seen, and in the concavities of which quartz crystals are spread, some crystals of *sulphuret of lead,* small clusters of crystals of *yellow pyrites,* rich in gold, some *silicious per-oxide of iron and clay,* and *hydrous oxide of iron,* both auriferous. The walls of these small *veins* presented on both sides a coating of hardened ferruginous clay with silica a quarter of an inch thick, and the surfaces perfectly polished. This coating was also auriferous, as mentioned already. The gold from these seams was in all points identical with that from the mass traversed by them. *The residuum* produced by the process of washing the mass or rock * and that of the pulverised vein-stone were also identical, being both auriferous.—As already observed, these seams, of a wedge-like form, extended only towards the superior portion of the conglomerate, occupying a short distance in length and depth, but without reaching to the surface of the mass within three or four feet, *i.e.*, enclosed in all directions, constituting what may be termed isolated receptacles of auriferous materials. This as yet unique example of metalliferous veins † though repre-

* The conglomerate is disintegrated easily by agitation in water.

† These petty seams enclosed five metals—gold, silver, iron, lead, and aluminium!

sented on a reduced scale, gives us a splendid view of the development of auriferous veins in general. Truly, when we contemplate the non-connection of these seams, the important fact authorises the following conclusion:—*That the contents of these receptacles of mineral and metallic compounds, all of which contain gold, and are deprived of communication from all but the surrounding auriferous mass, naturally originated from this mass!*

The next inquiry will now be about the origin of the gold disseminated in the conglomerate. By the appearance of the mass, we have every reason to view it as the result of disintegrated materials, brought together by the agency of water. The evidences for this conclusion are presented in the well-rounded or waterworn fragmentary rocks imbedded in the mass, also in the globular fragments arranged in the pyramidal exhibition of geological structure. It appears that the gold existed previously, just as it is found mixed with the argillaceous mass; and, where are we to look for the origin of these so copiously provided gold-particles? Though the neighbourhood of the locality we have here observed has been occupied with gold-seekers for about two centuries, and during the last fifty years examined with more zeal and activity than in former days, the gold-producing veins or lodes have in this valley been found in a very small number, and of such poor materials, that of the three which have been discovered, one only merited attention, and that merely for a very short time. Consequently, the rocks that might have provided for the gold at the locality here under notice, are, at present undiscovered, and the sources for the same remain therefore, among many other questions, unanswered.

That no connection whatever exists between the gold produced from the Conglomerate and the auriferous quartz-seams and that collected close to this locality from the fluvial sources of the rivulet which crosses through the Conglomerate and the river bordering the foot of the hill—at the top of which the Argillo-feldspathic Conglomerate exists—is proved by the following comparison:—

Gold from the Rock.

From the conglomerate producing gold-particles of a fungiform, irregular, rough surface, 14. 10-12 carats: From the veinstone in the seams, the exterior aspect of the metal being identical with that of the above gold, though in somewhat larger grains, 14. 10-12 carats. Alloy, silver.

Fluvial Gold.

From *the streamlet*, close to the conglomerate, small, rather thick spangles, with rounded outlines, 19. 3-12 carats. From *the river*, rather larger particles, rounded outlines, clean and smooth, 18. 9-12 carats. Alloy, silver.

Mineral and Metallic compounds contained in Auriferous Veins.—Gold, always in a metallic state, occupies a limited number of rocks, usually quartz filling the fissures, and generally forming the gang or vein producing gold. But well-known exceptions have been noticed in S. America, where *bi-sulphuret of iron* forms the gold-producing veinstone, associated with some quartz and other minerals, in a comparatively small proportion. It is now an established fact that *pyrites* will always show traces of gold, and in some instances prove very rich; but what is not generally known, is the following truth, viz., that the bi-sulphuret of iron rarely exists alone with gold, some other auriferous matter being involved in the pyrites which carries the gold. This fact gives consequently a fair explanation why auriferous pyrites is difficult to reduce in a perfect and profitable manner. To convert the black oxide of iron into a red oxide is certainly the step required for separating gold-particles involved in the pyrites; but when we see that this metal is associated with some other compound, any operation that might eliminate or free the gold from the pyrites, will be found insufficient—this, many vain efforts have proved, and very reasonably so, from the fact alluded to. Bi-sulphuret of iron is, therefore, the most difficult, and quartz the easiest of all gold-bearing minerals capable of being reduced so as to separate the gold.

Quartz, carbonate of lime, rarely sulphate of lime, ferruginous lime, argillo-ferruginous compounds, also clay in its plastic state, fluor-spar, sulphate and carbonate of baryta, schorl, tourmaline, chlorite, &c., are also found in auriferous veins.

Quartz being the most prevailing of minerals in which gold is contained, has received the title of its *matrix*. In calcareous minerals, in schorl, and tourmaline, gold has not been seen, at least in South America.

Metallic compounds occupying auriferous veins, being auriferous.—Bi-sulphurets of *iron, lead, silver,* and *copper,* green carbonate of *copper,* mixed *copper* and *iron-ores, tellurium, arsenical-iron,* earthy carbonate of lead, and chloride of silver. *Per-oxide of iron, with silica and clay,* in an indurated and foliated state, *specular iron-ore,* and *hydrous oxide of iron.* Of these compounds, the pyrites, the bi-sulphuret of lead, the silico-argillaceous compounds, and the hydrous oxide of iron are the most prevailing, next to the quartz.

The following general conclusions seem to be adopted all over the world, viz.:—the sides or backs of veins pro-

ducing copper, tin, zinc, antimony, lead, nickel, and bismuth, and also the ferruginous quartz (in Cornwall known by the name of "gossan") are generally found auriferous, though not so much so as to answer the object of a commercial speculation. The hydrous oxide of iron * also termed bog-iron ore, and found abundantly distributed in most parts of the world, will always prove auriferous. In South America this ferruginous compound having been observed from various localities, has invariably produced some gold; this metal being distributed in microscopical particles. In corroboration thereof, it may be stated, that a vast deposit of hydrous iron-ore in Hanover was lately examined and duly analysed by A. T. Abel Esq., of Hamburg, and found not only auriferous but even rich in gold, so as to present a remunerative field for speculation in two branches of mining enterprise, *i.e.*, for *iron* and *gold*. Wherefore, there exists every reason to believe that gold is more widely spread over the earth's surface than has heretofore been imagined.

Metallic compounds existing in auriferous veins but rarely carrying gold :—

Bi-sulphurets of *zinc, antimony, arsenic, white oxide of antimony, chromate, phosphate,* and *molybdate of lead;* also, *carbonate of bismuth.*†

White pyrites, often found in the rocks adjacent to the vein, or in rocks forming the bed for fluvial depositions carrying gold, or occupying crevices of decayed or petrified wood among fluvial detritus, does not produce even traces of gold.

Hydrated oxide of iron, found in a very fine powder, encloses a microscopical gold-dust, partly to be detected on the deep-brown ground of a velvet appearance, as is observed not only in South America, but in other quarters of the world. The gold-particles found among the specular iron-ore are always found of a lamellar shape, and small size. Sulphurets of copper when auriferous, produce gold in very small particles, of angular shape. The mixed oxides of iron and copper prevailing in Peru, there called "*Pacos,*" produce a diminutive gold, also of angular shape, often proving very rich. Gold has also been found in veins producing quicksilver, ore, but not involved in cinnabar.

* It is supposed that this compound originates from decomposed pyrites?

† Carbonate of bismuth, with some oxide of iron, containing about 60 per cent. of gold, has been found at Kingower, Victoria; a sample of this rare compound was kindly presented to the writer by Wm. Birkmyre, Esq.

Cupreous ores existing with the auriferous veinstone, naturally impart their metal to the gold, just as the auriferous minerals, spread among copper ores, show a small quantity of gold among tons of copper. These facts prove that the bi-sulphurets of iron are the means by which gold is introduced among copper ores, just as copper-pyrites among the auriferous veinstone originates an alloy of copper in gold; and, therefore we find that copper is not a natural alloy of gold in the veinstone, neither does this metal ever make an alloy with the fluvial gold, silver being the only prevailing and natural alloy of gold in general. Chemically pure gold has not, as yet, been found in nature.

The exterior appearance of gold from the rock is most varied, both in size and configuration, from microscopical particles to those increasing to the weight of from grains up to pounds, though of the latter accumulations the rock gives very rare examples.* Gold from the vein is occasionally found in a free state on the surface of the mineral enclosing the greater part of it, but mostly this metal exists incorporated with the mineral and metallic compounds constituting the gold-producing materials of the gang or vein. The prevailing state is in an infinite variety of *fungiform, capillary, ramified* and other most singular forms; the lamellar form being rarely met with in gold from the rock. Among such exceptions may be named what I saw in El Valle de Osos of S. America, where some few thin gold plates were found in fissures of quartz from one of the few veins of that neighbourhood, exactly filling the seams, with two lamellar pieces of gold $1\frac{1}{2}$ inch long, $\frac{5}{8}$ wide, and 1-64 of an inch thick, forming a true parallelogram of nearly sharp angles. This unbounded irregularity in the form of gold as found in rocks, entitles this metal to the name of *amorphous*.

With regard to gold from fluvial deposits, whether observed in the finest dust or in larger particles, its form presents the greatest variety of fantastical configurations. Among the fluvial gold is also found the deposition of crystals in a cube, a regular octohedron and some other modifications, though these are but rarely seen. Crystals of this or any other form, as far as my experience goes, are not found among gold in the rock.

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* In New South Wales, Australia, a quartz-block found on the surface, contained various larger and smaller particles of gold of a pale yellow colour, of irregular and rough shape (fungiform) to the weight of 106 lbs. !

Gold in its natural state is always found alloyed with silver. When copper partakes of the alloy, it may be viewed as accidental, as has been alluded to in a foregoing paragraph. We also know that silver invariably presents traces of gold, wherefore a natural affinity between these two metals is observed throughout the world. Gold is generally associated with lead, and the sulphuret of lead in some instances is even rich in gold.

Native copper shows traces of gold. Iron may also be reckoned as intimately associated, because whether in the the form of pyrites, or in a decomposed state, as in the ferruginous clay, or in the hydrous oxide of iron, or with the ferruginous quartz (gossan), there are to be seen traces of gold, and often in considerable quantities. Native bismuth has occasionally gold adhering to it.

In former times "the electrum" of Pliny presented an object of curiosity. A specimen of what was known as electrum having been found at Schlangenberg, in Siberia, was analysed by Klaproth, and proved to contain 64 gold 36 silver. The said proportion corresponds with 15⅜ carats. This alloy, in times past, was looked upon as a curiosity. As a great variety to the proportions of gold and silver in the alloy are often met with among samples, taken even from the same rocks and the same vein, a singular example will here be submitted to show the varieties found in a single locality, which I examined a few years ago.

Gold from the pyrites forming veins in the Greenstone porphyry, in the Supía district of South America:—

Argentiferous Gold.

MARMATO VEINS.	Gold.	Silver.
Free gold (rarely found) in particles from 10 to 20 grains	75·00	25·00
Ditto, seldom seen	67·01	32·99
From mixed ores	65·79	34·21
Ditto	56·25	43·75
Produced by washing the residuum, pulverised sulphuret of lead	53·13	46·87

Auriferous Silver.

MARMATO VEINS.		
Residuum, sulphuret of lead	46·87	53·13
Ditto ditto	41·67	58·33
LA PLATA (MARMATO VEINS).		
Mixed ores, argentiferous gold	56·75	43·25
Residuum, black sulphuret of silver	37·82	62·18
LOAISA (MARMATO VEINS).		
Free gold in particles of about a dwt.	37·71	62·29

The pyrites of Marmato, being the prevailing compound in the several veins occupying this district, is also found in the other two localities. In the same district, but at a distance of a few miles, the veinstone at Botafuego produces gold of a higher quality or gold 90,91, silver 09,09.

The assays of the gold produced in these veins, all of which were from the same locality, and from the same quality of ore, show a gradual decline in the quality of gold from 18 to 9 carats; this remarkable difference in alloy originating from the metallic compounds by which the gold is associated in the pyrites, the *free* gold-particles containing *less silver*, and those with the sulphuret of lead, *less gold*.

From these facts it may therefore be deduced, that if formerly it were supposed that gold, in its native state, maintained a determined proportion with regard to its alloy of silver; there certainly remains no further doubt about these metals being *isomorphous*. This fact has been proved many years ago, with regard to the nature of gold from the Ural mountains; carefully investigated by M. Gustave Rose.

Returning to the supposed analogy between gold from the rock and that produced from fluvial deposits, it may be here proper to state the appearance and alloy of the fluvial gold collected in the neighbourhood and close to the porphyries of Marmato. The mountain-ridge of this locality being the most elevated point of the Supía district, and situated to the north of the fluvial deposits on the Supía plains and to the west of the Cauca river, might be supposed to have contributed to the auriferous nature of the fluvial detritus, settled at a short distance and at a lower level, but such is not the case.

Superior Fluvials, of the neighbourhood of the Marmato veins (Alluvial):—

The streamlet Obispo, passing over the porphyry, produces small lamellar gold, in well-rounded particles of clean and bright surface, its quality being 20. 1-12 carats.

The River Supía, passing over the plains; its gold being of flat form, well rounded outlines, clean and bright yellow—its quality, 22. 9-32 carats.

The border of the Cauca River, at low water, to the south—gold of a small flat grain, well-rounded outline, clean and bright surface—quality, 19. 25-48 carats.

The border of the Cauca River, at low water, to the north—gold in small lamellar particles, well-rounded outlines, clean and bright surface—quality, 20. 11-24 carats.

Lower Fluvials.—(Diluvial).

Plains of Supía—about four miles distant from the Marmato veins. The gold is here found in somewhat larger flat grains, thicker, of irregular shape, and rounded outline, even the smallest particle showing a similar form—the larger grains covered with a film of per-oxide of iron, 21. 13-44 carats.*

Banks of the ancient course of the Cauca River.

Upper stratum—The gold being lamellar, of irregular shape, rounded outline, and having a smooth, clean surface, some larger particles found with a film of per-oxide of iron—quality, 16. 21-24 carats.

Lower stratum, being found a few feet below the actual course of this river, resting on a stiff arenaceous clay bed, its gold, existing partly in larger grains, all flat, rather thick, having well-rounded outlines and smooth surfaces, partly with a film of per-oxide of iron, 18. 15-48 carats.

Gold from the rock, found among the fluvial gold in the Supía plains, distinguished by its fungiform, rough exterior surface and pale yellow colour, some crevices being filled with hydrous oxide of iron—occasionally found, and in very small quantities—quality, 14. 9-12 carats.

Gold from the rock, found among the fluvial gold of the banks of the ancient course of the Cauca River, in the lower stratum—well distinguished by its rough, irregular, sharp outlines of a fungiform appearance, occasionally found in very small quantities—quality, 15. 3-12 carats; silver being the only alloy with the gold here referred to.

In comparing the quality of the gold produced from the veins in the porphyry, as already mentioned, where we see that the prevailing quality of the larger quantities of this metal gives, on an average, from 10 to 15 carats, whereas the gold from the higher and lower fluvials of the said neighbourhood shows a much higher carat, or ranging from about 18 to nearly 22 carats—we certainly have no inducement whatever to presume that the gold among the fluvial depositions has ever occupied the immediate veinstone above. Wherefrom the fluvial gold of a purer nature has originated, as seen in this and many other localities, when duly investigated, is a secondary question; suffice it, at present, to show, that in a great many districts of the auriferous part of our globe the fluvial gold presents no analogy with that at present existing in the rock.

* The bright yellow of the film has led to the name of "Oro Colorado"—(red gold.)

In Victoria, Australia, we also find that a difference exists, with regard to the quality of gold from the veinstone and that from the fluvial depositions. From assays made of gold from Clunes, distinguished for its auriferous quartz veins, the following is the fineness of its gold, according to the assays made by William Birkmyre, Esq., and kindly communicated by him to the writer:—"The gold from the quartz reefs at Clunes varies in quality from 23. 04-8 to 23. 1. 4-8 carats."

"The alluvial gold, assays 23. 2. 4-8 carats."

Consequently there is a difference showing a higher quality of the fluvial gold of one-fourth to one-half of a carat.

Bendigo district, according to assays made at the assay-office of Messrs. Clarke and Sons, in Melbourne:—

Fluvial gold - -	22-3 6-8 to	23 0 2-8 carats
Gold from the veinstone	21-2 7-8	
Fluvial gold from Epsom	23-2	
Ditto Gipps Land	20-3 2-8	

Gold from the veinstone has been found as low as from 15 to 18 carats, the lowest fluvial gold being 20 carats. This shows a considerable difference in the higher quality of fluvial and lower quality of vein-gold of Victoria.

FLUVIAL GOLD.

The geological date of the fluvial depositions, among which gold makes its appearance, may reasonably be looked for at that period of the tertiary era when in England varieties of terrestrial mammalia (as the horse, dog, pig, the deer, the woolly elephant, and others) were destroyed, and consequently entombed under deep layers of sand, gravel, and clay; these strata being now designated as "mammaliferous crag." These changes were not very distant from the time when those extensive longitudinal narrow accumulations of sand and small pebbles were piled up by mighty currents, as seen in Ireland in "the Escars," and in Sweden, as the "A°sar;" and at the period when caverns, in different parts of the world, were for the last time visited by their occupants—who all, in the hour of horror and conflict, terrified by fear, were by a natural impulsive instinct driven to their supposed refuge. In those awful moments of overwhelming destruction, we may imagine how the powerful and the weak, the ferocious hyæna and the timid deer, met to suffer together. About this period, when destruction seems to have prevailed in all quarters of the globe,

and huge masses of gravel, sand, and clay were carried forth from the more elevated tracts of South America towards the sea, where, among others, the gigantic Megatherium and Mylodon (Sloths) and the Glyptodon (Armadillo), which occupied the vast plains of Las Pampas, were destroyed, as testified by their remains in this and similar localities.

What has been distinguished by "diluvial detritus," whether with or without gold, is the produce of this geological date, consequently the first appearance of gold among fluvial depositions may, with other eventful arrangements, be classed among the last of the tertiaries, *i.e.*, the *Pleistocene period*.* But where we find the remains of occasionally numerous proofs of the occupants existing previous to the catastrophe represented by these fosiliferous depositions, we have to consider that the destruction of these organic beings had been caused by a prior and preparatory arrangement to that of the deposition of the entombing detritus, viz., the preliminary work of *denudation*, for certainly a denudation took place previous to the successive depositions; because, wherever we observe the detritus of the epoch in question, we find that it rests on the naked rock, consequently, life and vegetation of the previously existing period naturally suffered first the effects of the devastation which worked its way down to the more solid rock, or the bed prepared for the materials employed in levelling the rugged surface of the earth.

Great and awful do those preparatory geological changes appear, when we view the existence of a luxuriant vegetation, animated by organic life in numerous forms and enjoying a tranquil possession of their respective abodes, when the hour of destruction arrived, and the last denudation that our globe had to suffer came to hand. It appears that among the agencies employed, the most powerful consisted in those from meteorological sources. We admire the wonderful effect of these, though with but a faint idea about their extent, as far as our present notions of such agencies reach, because, since the epoch we now contemplate, our globe has not experienced any such floods as those producing the denudation and consequent distribution of the fluvial-detritus containing gold—which may be considered as partial and local changes, carried on in succession all over the world. The portion thus exposed to the catastrophe, became deprived of all

* *Pleistocene*, the last of the geological divisions of the Tertiary epoch—revealing the recentness of the great majority of fossils.

existing organic and inorganic objects—gigantic forests were torn up by the root, all soils and strata were removed—in a word, all but the firm rock had to yield to the mighty floods, which carrying off all before them, naturally brought their vegetable and animal spoils through immense outlets, which for the most part terminated at the sea, where they were buried. For this reason, in many localities, vestiges of the higher order of animal life, and of the then existing gigantic vegetation, are not to be found; though in some, those interesting relics of a far remote past are recorded in the annals of geology.

The denudation having been completed, the sites of former luxuriant woods and verdant fields, occupied by numerous animated beings, were destroyed—whole tracts converted into naked hillocks, barren plains, and deep furrowed channels, in which the objects of destruction were still moving as the remainder of their spoils, leaving at intervals some temporary reservoirs, stored with materials for the following arrangements, *i.e.*, the levelling operations, or the distribution of the Pleistocene materials, viz., the diluvial detritus. In these temporary reservoirs we may imagine that the animal remains had been retained, awaiting their ultimate entombment with the deposits in which they are transmitted to their present observers or admirers.

The portion of our globe thus treated represented a desert, as it were, in total abandonment. Did it remain in this desolate condition for any length of time? There exist reasons to suppose that it did so:—1st, as we in various parts of the globe find that the diluvial detritus rests on a decomposed rock (granitic or schistic), which change must have taken place by exposure to the atmosphere, posterior to the denudation; 2nd, in some arenaceous clay-beds of the preceding geological period we see great fissures, which are filled with diluvials carrying gold, wherefore it appears that these fissures were produced *posterior* to the denudation; which circumstances indicate that a considerable length of time would be required for their accomplishment. In certain districts of the globe it also appears that after the denudation an *intermediate period of quietude* had prevailed before the outbreak and distribution of the subsequent detritus, as several kinds of conglomerates were deposited, masses of a porous quartz and ferruginous clay, also conglomerations of bones in great numbers cemented together by a ferruginous compound. These accumulations demanded a slow and

quiet process during a great lapse of time. It thus appears beyond any doubt that the *pleistocene epoch* partook of a preliminary period of inactivity or rest, and that the geological operations were carried on in two distinct divisions, which by the existing productions from that time show one partial or peculiar distribution limited to certain localities of our globe, and another more extended or general distribution. The latter is represented by the fluvial detritus, to which has been given the distinctive term of *diluvium*, and this period and the detritus then distributed shows the earlier of the two fluvial operations carrying gold—the latter of them receiving its distinction by the name of *alluvium*.

Diluvial detritus carrying gold and covering the auriferous strata.—The lowest stratum resting on the denuded rock will generally be found auriferous, consisting frequently of *sand* and *pebbles*, or *sand* and *gravel*, in South America and California, with very rare exceptions, perfectly rounded or waterworn. Boulders and other smaller fragmentary rocks are also found in some localities all more or less waterworn. Clay is not frequently found in admixture with the strata of sand and gravel. Clay, more or less arenaceous, constitutes separate layers, and on the top of these, sands and mud (or finely pulverized mineral compounds) with more or less argillaceous matter, colored by per-oxide of iron, of a variegated hue. Among these superior strata, gold is occasionally found, in the elevated tracts of South America, from about 5,500 feet to 10,500 feet above the sea. Strata of mud, of considerable thickness, occupy the superior portion of the diluvium, being covered with a thin coating of vegetable soil. These depositions consist of most diminutive particles of silica and talc, occasionally mica, being coloured with per-oxide of iron, light brown and yellow—when in their natural moist state, unctuous; but when the mass becomes dry, it is nothing but a fine loose powder. No argillaceous matter is found with this, called by the natives "soapy earth," which is well known for its sterility, and where it prevails it seldom covers any productive auriferous detritus. In some localities of South America, a ferro-argillaceous compound with silica, of the colour of rust, several inches thick, appears on the top of the diluvial detritus, covered with a thin coating of vegetable mould. In other localities the very same compound is found at a further depth, covering in the same manner the lower auriferous stratum. This hard compact cement has not proved auriferous.

Only in one locality a deposition of *polishing slate,* the produce of *Infusoria,* has been found by the writer, resting on the auriferous detritus, and being of 25 feet thickness.

In California, the auriferous strata are seen on the bed-rock, with great accumulations of well-rounded gravel and stone, with rough sand, also arenaceous clay-beds cover to great depth the gold-bearing materials, which occasionally are mixed with clay. Many auriferous layers are covered with calcareous conglomerates of fragmentary, angular rocks (there termed "*lava!*") very compact and hard, occupying a thickness of upwards of one hundred feet. In some localities, the first and auriferous stratum resting on the bed-rock, consists of pebbles and sand, cemented together with ferro-siliceous clay and forming a hard mass several feet thick.

In Australia, the diluvial auriferous detritus is generally found to consist of sand and small angular fragments of quartz of a yellowish white hue, the strata being more or less argillaceous, and frequently all the deeper deposits consist of more clay than sand, always with partly angular and partly rounded fragments of rock, and more or less quartz-débris. The old outlets or channels, from the time of denudation, existing along the cleavage of the schists and furrowed in a very irregular direction, are found to the depth of nearly four hundred feet. The auriferous detritus, consisting mostly of plastic clay, with some gravel and sand, occupies a varied thickness of from a few inches to several feet. At an inferior depth, *i.e.,* at the higher portion of the channel, a stratum of basalt, about 50 to 70 feet thick, covers the auriferous sandy clay; and, in proportion, as the depth of these channels increases, the basalt-beds augment; and at about the depth of 400 feet, four distinct layers of basalt are found, between each of which, diluvial matter marks the lines of division. This part of the world only has shown that a volcanic production covers the *fluvial detritus,* thus most carefully concealing the treasures of the epoch. (Ballarat, &c., Victoria.)

In some localities the auriferous stratum consists of sand and gravel, cemented together with a ferro-siliceous clay, forming a perfectly compact, hard mass, of a light-brown colour.*

Where the trap or basalt does not constitute the superior strata of the auriferous drift, a more or less argillaceous and well-pulverized detritus furnishes the layers by which the

* The process of stamping is required for disengaging the gold particles from the conglomerate.

riches are concealed. What should be termed vegetable soil is often very scanty, but where trap and basalt prevail, it is produced by the decomposition of these rocks.

The bed on which the treasures of Australia have been deposited consists for the most part of slate—siliceous, chloritic, micaceous and argillaceous,—occasionally intermixed with a very compact sandstone; alumina and mica schists being the prevailing material, and frequently found in a decomposed state, termed by the miners "pipe-clay." On the lower tracts, towards the sea-coast, a ferruginous and a calcareous sandstone are found above the clay-beds. In these localities the fluvial depositions have been proved to contain little or no gold.

By what is observed in various auriferous districts of the world, it appears that the materials first deposited carried with them the principal portion of the gold, as the superior strata contain little or nothing of this metal. Clay is seen to prevail in some districts, more abundantly mixed with the auriferous strata than in others, and when we look into the nature of the locality where the plastic clay abounds (certainly very much increasing the toil and labour of the gold-seeker) we find that were it not for the clay, those more abrupt and narrow channels, where such treasures are found, would not have retained the often diminutive gold-particles. With only sand and gravel these would have been hurried on too far, perhaps into the sea, and thereby lost. There can remain no doubt, as to the powerful agency in the floods by which these masses were moved and transported within narrow spaces (the so-called gutters in the deep sinkings of Australia). Consequently, when duly considered, it will be found that without the admixture of clay, many localities would not have retained the treasures now accumulated for the use of man. Thus, we observe from an apparently insignificant circumstance, that foresight and wisdom ruled in every department of geology.

Appearance and alloy of gold distributed with the diluvial detritus.—Gold, from *the first fluvial* depositions, is found of a most varied exterior and size, from the finest dust, the particles of which are generally of a flat form, increasing to the weight of grains, dwts., ozs., and lbs., the shapes of which show the utmost imaginable variety, the surfaces being smooth and often bright and clean with rounded outlines, apparently what is termed "water-worn," and there can be no doubt that in some localities the fluvial gold has been carried a great distance previous to subsiding.

In South America, the fluvial gold (the miners' "*oro-corrido*") in all auriferous localities, presents a characteristic that is not so generally met with in other parts of the world, because the fluvial gold, whether from the North or the South of this continent, is found of a flat, smooth, rather ovoid shape with well-rounded outlines, sometimes bulky and more irregular in form, but generally clean, and never attached to any mineral or metallic compound whatever. There are certain localities where the gold-particles assume such an equality in their exterior, that they may be compared to some of our well-known cereal productions. This fact is so generally known and attended to, that on viewing "the grain" of the gold, the locality is recognized as well as the commercial value.

The Spanish Government obtained a considerable income by the so-called "quinto-del oro," or the tax paid on gold-dust, and it may be worthy of notice that during nearly three centuries, while the fluvial mines produced great quantities of gold, there were not worked in the whole extent of South America half-a-dozen auriferous veins, and these with a very scanty produce. Even in later years, when more attention has been given to the gold producing rocks, only a limited number of the same have proved commercially productive, and the greater number of such veins produce their gold of a lower quality, containing, as it does, a greater alloy of silver than the fluvial gold.

One among several fluvial auriferous deposits of South America, remarkable for their geological position, will here be briefly noticed, as existing on the undulating table-land of El Valle de Osos of Antioquia. This plain, at an elevation of 9150 feet above the sea, constitutes one of the most elevated, isolated flat localities of the district, presenting no mountain ridges, or, as they have been called, "backbones," diversified only by a single perpendicular hill, bordering on the northern part of the plain—which is surrounded with the valleys of Medellin and Cauca, over which it is elevated from 4000 to 7000 feet. The fluvial detritus, occupies somewhat more than 150 feet in thickness, and is spread over an area of 100 square miles, resting on granite, more or less decomposed. Here the observer certainly finds no mountains where the auriferous rock might have contributed to provide for the auriferous gravelly sands resting on the granite bed. This deposit has been worked for about 150 years, though only in the rainy periods of the year, and is

the property of a few proprietors. In the year 1827 there were discovered two or three quartz veins, producing gold, traversing the granite, and found below the fluvial detritus. I shortly after went to see these discoveries, and found that among them only one quartz vein was worked with good profit. That no connexion between the gold from these veins and that gathered from the fluvial detritus can be found, will be explained by the following comparison of the gold got from the different positions.

Gold from the veinstone in the Granite below the auriferous fluvials.—The appearance being *fungiform, irregular and with rough outlines,* the particles of a few grains weight, of a pale yellow colour, veins No. 1 and No. 2 presenting the same appearance.

Assay of No. 1	gold 70·84	silver 29·16
Do. No. 2	,, 68·76	,, 31·24

Gold from the Fluvial detritus resting on the Granite above the Veins.—The appearance being lamellar, thin particles of a rounded outline, quite smooth and of clean surface, the largest particles about the size of a linseed, and partly very small flat grains, of which the number of 60 were required for the weight of one grain, the colour being a deep yellow. When seen with the microscope the larger grains had a deeper yellow shade round the exterior outline. From one of the localities a few slender particles of platinum were observed, this being the only locality within the boundary of Antioquia where platinum has been found.

Assay from locality No. 1	gold 83·00	silver 17·00
Do. No. 2	,, 88·21	,, 11·79

The highest quality of gold in South America is found among the fluvial productions, where to the north of the equator, in Pamplona, it gives 98·95 gold and 10·05 silver, being a very fine lamellar dust.

In California the fluvial gold has also produced the highest quality, showing but a small fraction below that just named from South America.

In Australia the highest quality or purest gold is also found among the fluvial detritus, from whence also the largest mass of this metal has been taken from a locality, at the depth of 160 feet, the gold resting on micaceous clay slate. The shape of this curiosity presented two distinct masses bound together by a flattened piece of gold, about 1 and 1½ inch in dimensions, but the smaller portion covered the larger ex-

teriorly, so that in a certain position it appeared to be one single lump. The outlines were all rounded, the mass having a rounded oval shape. Where it had been well cleansed from the clay, there were marks seen all over similar to the impression made by the point of a finger on clay. No quartz was intermixed with the mass, but small quartz pebbles were seen among the clayey earth still adhering to certain inequalities. As the mass had not been perfectly cleaned, its true yellow hue was only partially perceptible. The length was about 18 inches, the greatest width about 13 inches. The weight, as stated, was 2195 ounces; its quality (by assay of William Birkmyre, Esq.) 99,20 gold, 00,80 silver: thus constituting the largest mass of, and purest gold yet found in the world.

The lowest quality of gold from Australia, being among exceptions, is 62,50 gold, 37,50 silver; but most of the gold-fields give gold from the fluvial deposits of from 93,00 to 97,95; wherefore of the known auriferous districts in the whole world, Australia produces on an average the highest quality, and as far as I have had an opportunity of observing, when gold from the rocks is compared with that from the fluvials of the same locality, the latter shows a less proportion of silver.

In some districts, the early fluvials carrying gold produce also another valuable metal, viz., *platinum*. In South America, particularly in *Chocó*, and *Barbacoas*, platinum is always found associated with gold, in the proportion of from 25 to 75 per cent. The appearance of this metal and its usual associates is in small, flat, partly oblong, rather thick grains, having well-rounded outlines, and always a clean, bright surface. In Brazil, platinum is also found mixed with gold, in about similar proportions; but there the particles of this metal are seen in a fungiform or porous state, and in rather larger grains. The residuum, or the black sand accompanying the gold and platinum, from the said localities, has generally been found to be *titaniferous iron oxidule*, this being the "*volcanic sand*" of *Berzelius*.

Platinum has been found in Santo Domingo, among auriferous fluvials, also in small particles. The Ural Mountains have produced great quantities of platinum, accompanied also with fluvial gold. Platinum, though found among the auriferous drift, is not known as existing in the rock,—its "matrix" is supposed by some to be "talc." Its origin is therefore unknown, and cannot be accounted for, like that

of gold, "by disintegration." Palladium is well-known to be a natural alloy of gold, in Brazil.

Copper in a native state, in small, flat particles, was found by the writer in one of the early auriferous diluvials of Antioquia, in South America, in the proportion of about 10 per cent. of gold with the copper.

Metallic Compounds found with the early fluvials producing Gold.—Cinnabar, grey manganese, wolfram, wood-tin, and the more common per-oxide of tin—this last being found abundantly in Cornwall, some parts of South America, and more recently in Victoria, Australia, &c. Sulphate of mercury, titanite, negrine, rutile, prot-oxide of iron, magnetic-iron, specular iron-ore, chromate of iron, and titaniferous iron-oxidule—most of these compounds prevailing among fluvials, and by the gold-seekers termed "black sand."

The most valuable of gems or precious stones are found in the auriferous diluvials of earlier date; this apparently being the period when these articles of wealth and luxury were distributed (diamond and ruby).

Having thus briefly noticed the peculiarities about gold, as found in the rock, and this metal as encountered among the early fluvial deposits, we will shortly dwell on the question of the analogy between the two auriferous sources, and particularly with reference to the prevailing hypothesis for the origin of fluvial gold, by the Spanish miner termed "oro-corrido," and by the gold-seeker of modern times known by the name of "wash-gold."

Our first inquiry will therefore be—At what geological period were the auriferous materials deposited in the rock, in the form of a vein, as now actually seen?

Supposing that the auriferous veinstone existed previous to the tertiary era, may we not ask—how is the prevailing total absence of gold in the detritus prepared and deposited during the three earlier periods of the tertiaries, viz., the Eocene, the Miocene, and the Pliocene to be accounted for? These formations were produced from disintegrated rocks, by the agency of water, similar to the Pleistocene, when the auriferous materials made their first appearance among the fluvials. To the latter period a distinctive term, that of "diluvial epoch," is applied, as representing the immediate results of the last preparatory denudation which visited our globe. Gold and precious stones were deposited on the denuded rock at this period, and by this natural concentration are now easily found and removed.

During the course of the turbulent era of denudation, we have every reason to suppose that all attainable rocks, whether auriferous or not, were exposed to the violence and destructive agencies of the epoch, and naturally worn down, when the gold-bearing shared the fate of the rest of the rocks, being equally exposed to the process of disintegration and ultimate denudation. And when we reflect on the fact of all such rocks being left in a bare or denuded state, we may also imagine that the volume of water which apparently performed the work of gathering and carrying off all which came within the reach of its mighty moving force, was transported by the existing outlets and accumulated on the bed of the ocean. The probability of certain reservoirs or natural dams, as already alluded to, may be viewed as a fact in many localities, by which means some of the materials of denudation were retained for further distribution. After all, it seems very difficult to form an idea as to the *modus operandi* by which the desintegrated matter during the denudation became stored for ulterior use.

Where gold-bearing veins have apparently made their appearance posterior to the early periods of the tertiaries, there we have no reason to expect gold as originating from the rock. Veins existing in stratified rocks may have undergone a change in position, as the rock itself, viz., been tilted up from a horizontal to that of a more or less vertical position, and if the materials forming the veinstone were deposited when the rock existed in this position, such would facilitate our ideas about the formation of metalliferous veins. The alteration from a horizontal to a more or less inclined position might have taken place at a period posterior to the epoch of the denudation of the rock itself?

Stratified vein-stone, carrying gold, is seen in several localities in South America. A rather singular instance of a stratified quartz-layer, being auriferous, is seen in Antioquia, where an undulated stratum of quartz rests on the granite, the superior portion of the same being covered with fluvial detritus, partly productive of gold. This stratified quartz was here deposited on the bare granite, consequently posterior to the epoch of denudation.

That many auriferous veins existed previous to the last denudation, there can be no doubt; but that all such veins were prior to the catastrophe of denudation, is a question which remains still unsolved. The answer may be expected at some future day.

Superior Fluvials carrying Gold (alluvial detritus).—After the several arrangements completed during the Pleistocene period, we may imagine what an immense lapse of time must have been required for the reconstruction of our globe's exterior, considering its condition at this time. In some districts where the last or superior stratum of argillaceous matter settled several hundred feet above the first layer of auriferous materials, buried at the beginning of the epoch, and in others, where the last mass of basalt flowed on to cover and secure the treasures of Australia.* In fact, at the close of the preparatory operations of denuding the earth's surface, desolation prevailed, and after the levelling operations had been completed, we may fairly imagine that the aspect of our planet was just about the same as at the beginning of the epoch we contemplate—nothing but a bare naked surface, the monotony which reigned being only interrupted by the sound of the gradually reduced waters. We may now suppose that the meteorological agencies had also abated.

But this quietude was once more to be interrupted, the agency of water being again required. Immense floods re-appeared with the object of forming many of the existing outlets for running waters, which now exhibited themselves but as small brooks passing through wide dales. These operations are well illustrated in several localities of Australia, not very distant from the sea-coast, where the trap and basalt beds have been thus furrowed. These rocks are sometimes well defined at an elevation of more than 200 feet above the actual water-course, which enables us to recognise the trap topping the ancient gravel-beds. These gravel-beds, by the fluvial action alluded to, have been changed into hillocks, called "gravel-hills," some of which present very abrupt outlines, and are now covered with soil, well grassed. Under these masses of fragmentary accumulations, mostly quartz, water-worn and well-rounded, the stratum

* The basalt and trappean rocks, covering these fluvial depositions, present extensive plains, the vegetation of which is supported by the decomposition of the rocks themselves. No moving waters have aided these accumulations of soil, which contain silicates of alumina and iron. These rocks are of a *post*-Pleistocene date. In some districts good illustrations of the perfect decomposition of granite exist, showing the gradual change of the solid rock into a plastic clay or silicate of alumina, in which the crystals of quartz and mica are well defined, and this even to a depth of several feet; a scanty black soil covering the top of the decomposed granite.

of drift, resting on the bed-rock (clay and chlorite schists) is auriferous, and at the lower part of the drift large rounded quartz-boulders are found resting on the perfectly decomposed schist. In California similar "gravel-hills" are observed, but there they present ridges of more extent and even more elevated, and above the auriferous stratum in some instances a calcareous infiltration has bound together the fragmentary accumulations; while in others a ferruginous solution has produced this effect. In the most of these hills a compact ferruginous conglomerate has formed for many feet in depth, and close to the layer of drift. This conglomerate often proves richer in gold than the *drift* itself.

It would now appear that the great work of the Creation, as it now exists, was approaching completion; still, previous to the re-appearance of a new flora, and the re-organization of animated beings, certain additional changes were required, for which the aid of water was yet necessary—some fluvial matters remaining to be distributed. Among the detritus of this period we find that gold makes its appearance, particularly in the superior strata of the beds of running waters and among the superficial decomposed mineral compounds which we know as vegetable earth. Among the results of this latter fluvial epoch may also be observed large accumulations of a finely pulverised sand, spread over plains which we distinguish by the name of deserts, and on which the wind has the power to form sand-hills of considerable extent.

Viewing the gold as it is found in those countries where moving waters abound—as in South America, where the writer has exercised careful personal observation, the precious metal is seen in small, lamellar, thin particles, all of well-rounded exterior, perfectly clean and smooth surface, generally not much larger than a linseed, the quality being—the lowest, 79·02 gold, 20·98 silver; and the highest 91·44 gold, 08·56 silver.

Mineral and Metallic Compounds associated with Gold of the last fluvial.—Titanic iron oxide, chromiferous oxidulated iron, oxidulated iron sand, prot-oxide and per-oxide of iron, rutile, titaniferous iron with manganese, nigrine, rarely oxide of chromium, oxidulated copper (Siberia), chloride of copper (S. A., Atacama). Most of these compounds appear in the form of a fine sand.

Among general remarks we may here state, that with the auriferous depositions of this period are found some precious

stones, though it is ascertained that the diamond and ruby belong exclusively to the earlier fluvials.

The first fluvial deposits of this epoch consist always of gravelly sand, resting on some of the depositions of the foregoing period; while in moving waters the auriferous stratum is occasionally found resting on the rock. Strata of clay of this period are generally observed above the first deposition. As has been mentioned, a very small lamellar gold is found among the vegetable soil in South America, even at an elevation of from 9,000 to 10,000 feet above the sea.

Fluvial gold is in Peru found at an elevation of 13,500 feet above the sea. In New Granada the writer found some very fine gold in the streamlets on the slope of the Paramo de Ruiz, at 12,500 feet elevation, this gold being accompanied by titaniferous iron sand. These elevated waters moving on graywacke, are supplied by the perpetual ice which here covers the crest of, and fills the interior of the extinguished crater, 2,950 feet above the brooks alluded to.

Gold in the Rock.—Quartz-veins in granite are seen close to the summit of the Paramo de Sonson of New Granada, at the elevation of 10,100 feet above the sea.

Fluvial gold is also found at the level of the ocean, as seen on the Asiatic and African coasts, also at Port Phillip, Australia, &c.

CONCLUSION.

By this brief view of the geological position of gold, we find that its distribution is threefold, viz.—in the rocks, the earlier (diluvial) and later (alluvial) fluvial depositions.

Though there may exist localities where the auriferous fluvial detritus has been provided for by disintegration of the vein-stone carrying gold, in South America especially, as has been stated, and also in other districts, the gold from the fluvial depositions presents no analogy whatever to that produced from the veinstone;* wherefore, the prevailing hypothesis on the origin of gold among the drift does not hold good, at least as a general fact; consequently some other explanation is required, and thus a new object for research is here offered into the secrets of the vast laboratory of nature.

After the apparently last geological arrangements had been finished, during the Pleistocene period, when the materials

* This fact has been familiar to the writer for the last twenty years.

which were to represent wealth and luxury were so favorably deposited, and in succession the levelling process had been attended to throughout the world, it would appear that our globe had attained that perfection which was required for the re-organization of organic development. Still the globe would merely have served the purposes of an irrational population, but not for the intelligent being who was not merely to master the animal tribes, but even to cultivate his own intellect. For this grand moral object certain material means were required, and for such an interesting object, means had to be provided. Consequently, completion was given to the great work, and this we find was performed by the agency of water, during the period we propose to distinguish by the name of Post-Pleistocene, being synonymous with post-diluvial or alluvial.

This last accomplishment in creation, of so great importance for the development of the intellectual faculties of man, gives us a renewed motive to admire the hidden and often imperceptible means by which the Creator, with such infinite wisdom, prepared an abode for the human race.

The philosopher, who may not as yet have studied the means so essentially required and provided for, if he views the "first leaves" of the often mysterious "Stone Book," will be gratified by the surprising and satisfactory answer revealed.